

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : C07D 401/06, A61K 31/40, C07D 209/34	A1	(11) International Publication Number: WO 95/01349 (43) International Publication Date: 12 January 1995 (12.01.95)
(21) International Application Number: PCT/EP94/01715 (22) International Filing Date: 26 May 1994 (26.05.94) (30) Priority Data: 9313638.0 1 July 1993 (01.07.93) GB (71) Applicant: FARMITALIA CARLO ERBA S.R.L. [IT/IT]; Via Carlo Imbonati, 24, I-20159 Milan (IT). (72) Inventors: BUZZETTI, Franco; Via Gallarana, 4, I-20052 Monza (IT). LONGO, Antonio; Via Porpora, 160, I-20131 Milan (IT). BRASCA, Maria, Gabriella; Via Dante Alighieri, 15, I-20090 Cusago (IT). ORZI, Fabrizio; Via Angera, 10, I-20125 Milan (IT). CRUGNOLA, Angelo; Via Ruggiero Settimo, 30, I-21100 Varese (IT). BALLINARI, Dario; Via Jannozzi, 8, I-20097 San Donato Milanese (IT). MARIANI, Mariangela; Via Milano, 298/A, I-20033 Desio (IT).		(81) Designated States: AU, BB, BG, BR, BY, CA, CN, CZ, FI, HU, JP, KP, KR, KZ, LK, LV, MG, MN, MW, NO, NZ, PL, RO, RU, SD, SK, UA, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report.</i>
(54) Title: ARYLIDENE AND HETEROARYLIDENE OXINDOLE DERIVATIVES AS TYROSINE KINASE INHIBITORS		
<div style="text-align: right;">(I)</div>		
(57) Abstract		
<p>Arylidene and heteroarylidene oxindole derivatives of formula (I) wherein, subject to provisos, Y is a bicyclic ring system chosen from naphthalene, tetralin, quinoline and isoquinoline; R is hydrogen or an oxo (=O) group when Y is tetralin; or R is hydrogen when Y is naphthalene, quinoline or isoquinoline; each of R¹ and R² independently is hydrogen, C₁-C₆ alkyl or C₂-C₆ alkanoyl; m is zero, 1 or 2; n is zero, 1, 2 or 3; each of R³ and R⁴ independently is hydrogen, halogen, cyano, C₁-C₆ alkyl, carboxy, nitro or -NR⁶R⁷ in which each of R⁶ and R⁷ independently is hydrogen or C₁-C₆ alkyl; R⁵ is hydrogen or C₁-C₆ alkyl; and their pharmaceutically acceptable salts, which are useful as tyrosine kinase inhibitors.</p>		

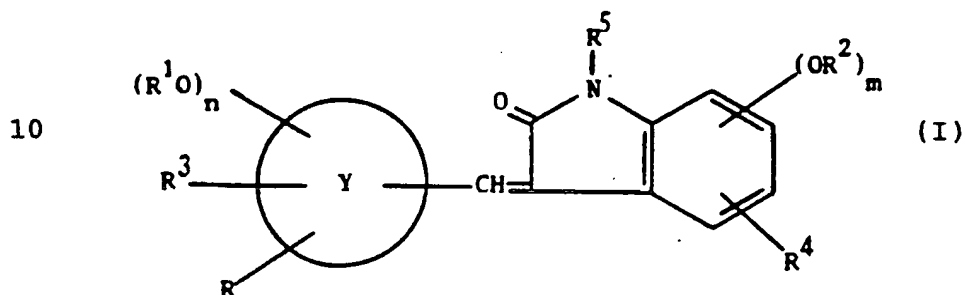
FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	GB	United Kingdom	MR	Mauritania
AU	Australia	GE	Georgia	MW	Malawi
BB	Barbados	GN	Guinea	NE	Niger
BE	Belgium	GR	Greece	NL	Netherlands
BF	Burkina Faso	HU	Hungary	NO	Norway
BG	Bulgaria	IE	Ireland	NZ	New Zealand
BJ	Benin	IT	Italy	PL	Poland
BR	Brazil	JP	Japan	PT	Portugal
BY	Belarus	KE	Kenya	RO	Romania
CA	Canada	KG	Kyrgyzstan	RU	Russian Federation
CF	Central African Republic	KP	Democratic People's Republic of Korea	SD	Sudan
CG	Congo	KR	Republic of Korea	SE	Sweden
CH	Switzerland	KZ	Kazakhstan	SI	Slovenia
CI	Côte d'Ivoire	LI	Liechtenstein	SK	Slovakia
CM	Cameroon	LK	Sri Lanka	SN	Senegal
CN	China	LU	Luxembourg	TD	Chad
CS	Czechoslovakia	LV	Latvia	TG	Togo
CZ	Czech Republic	MC	Monaco	TJ	Tajikistan
DE	Germany	MD	Republic of Moldova	TT	Trinidad and Tobago
DK	Denmark	MG	Madagascar	UA	Ukraine
ES	Spain	ML	Mali	US	United States of America
FI	Finland	MN	Mongolia	UZ	Uzbekistan
FR	France			VN	Viet Nam
GA	Gabon				

**ARYLIDENE AND HETEROARYLIDENE OXINDOLE DERIVATIVES
AS TYROSINE KINASE INHIBITORS**

The present invention relates to new 3-arylidene and 3-
5 heteroarylidene-2-oxindole derivatives, to a process for
their preparation, to pharmaceutical compositions
containing them and to their use as therapeutic agents.
The present invention provides compounds having the
following general formula (I)



wherein

Y is a bicyclic ring system chosen from naphthalene,
tetralin, quinoline and isoquinoline;

R is hydrogen or an oxo (=O) group when Y is tetralin, or

15 R is hydrogen when Y is naphthalene, quinoline or
isoquinoline;

each of R^1 and R^2 independently is hydrogen, C_1 - C_6 alkyl
or C_2 - C_6 alkanoyl;

m is zero, 1 or 2;

20 n is zero, 1, 2 or 3;

- 2 -

each of R^3 and R^4 independently is hydrogen, halogen, cyano, C_1-C_6 alkyl, carboxy, nitro or $-NR^6R^7$ in which each of R^6 and R^7 independently is hydrogen or C_1-C_6 alkyl;

- 5 R^5 is hydrogen or C_1-C_6 alkyl; and the pharmaceutically acceptable salts thereof; and wherein
- a) when at the same time Y is naphthalene; R^3 is hydrogen, halogen, cyano or C_1-C_6 alkyl; R^5 is hydrogen; m is zero and n, R and R^1 are as defined
10 above, then R^4 is other than hydrogen;
- b) when at the same time Y is quinoline or isoquinoline; R_3 is hydrogen, halogen, cyano or C_1-C_6 alkyl; n is zero, 1 or 2; R^5 is hydrogen; m is zero and R and R^1 are as defined above, then R^4 is other than hydrogen;
- 15 c) when at the same time Y is tetralin in which only the benzene moiety is substituted, R^3 is hydrogen, halogen, cyano or C_1-C_6 alkyl; n is zero, 1 or 2; R^5 is hydrogen; m is zero, R is hydrogen and R^1 is as defined above, then R^4 is other than hydrogen;
- 20 and
- d) when at the same time Y is naphthalene; m and n are zero; R and R^3 are hydrogen; R^4 being linked at the C-4 carbon atom is halogen or C_1-C_4 alkyl, then R^5 is other than C_1-C_2 alkyl.
- 25 The invention includes within its scope all the possible isomers, stereoisomers, in particular Z and E isomers and

- 3 -

their mixtures, and the metabolites and the metabolic precursors or bio-precursors (otherwise known as pro-drugs) of the compounds of formula (I).

The alkyl group, and the alkyl moiety in the alkanoyl groups, may be branched or straight alkyl chain. A C₁-C₆ alkyl group is preferably a C₁-C₄ alkyl group, e.g. methyl, ethyl, propyl, isopropyl, butyl, sec-butyl or tert-butyl, in particular methyl or ethyl. A C₂-C₆ alkanoyl group is preferably a C₂-C₄ alkanoyl group, in particular acetyl, propionyl or butyryl.

A halogen is preferably fluorine, chlorine or bromine, in particular fluorine or chlorine.

The term tetralin preferably is meant to refer to a 5,6,7,8-tetrahydronaphthalene ring system.

When the R oxo (=O) group is a substituent on the tetralin ring, said oxo group can be attached only to the saturated moiety of the tetralin ring, thus providing a 5-, 6-, 7- or 8-tetralone ring system, preferably 8-tetralone.

When Y is tetralin preferably the oxindolylidene substituent is on the benzene moiety whereas the R³ and the R³O-group(s) may be on either of the rings.

When tetralin is substituted at the position 1' by the oxindolylidene substituent, preferably at least one -OR² group is present at the positions 2', 4', 5' and/or 8' and preferably the R³ substituent is at the 4' position.

- 4 -

Analogously when tetralin is substituted at the 2'-position by the oxindolylidene substituent, preferably at least one -OR¹ group is present at the positions 1', 3', 4', 5' and/or 8' and the R³ substituent is preferably
5 at the 4'-position.

When Y is naphthalene the R³, the R¹O-group(s) and the oxindolylidene substituents are preferably on the same benzene moiety.

When Y is quinoline the oxindolylidene group is
10 preferably attached to the 4'- or 5'-position of the quinoline ring whereas the R³ and R¹O substituents may be on either of the rings of said ring system.

When Y is isoquinoline the oxindolylidene group is preferably attached to the 3'- or 5'-position of the
15 isoquinoline ring whereas the R³ and R¹O substituent(s) may be on either of ring moieties.

When Y is quinoline, it is preferably substituted at the positions 4' or 5' by the oxindolylidene substituent and at least one OR' substituent is present, preferably at
20 the 8' position.

Preferably at least one of the substituents R⁴ or -OR² is present on the 2-oxindole ring. Preferred substitution positions are the positions 4 and 5, in particular position 5.

25 When R⁴ is carboxy, nitro or -NR⁶R⁷ in which R⁶ and R⁷ are as defined above, the R³ substituent is preferably

- 5 -

other than carboxy, nitro or $-NR^6R^7$. Vice versa, when R^3 is carboxy, nitro or $-NR^6R^7$ in which R^6 and R^7 are as defined above, the R^4 substituent preferably is other than carboxy, nitro or $-NR^6R^7$.

- 5 Of course only one of the substituents R^1O , R^2O , R^3 , R and R^4 can be linked to the same ring position.

Pharmaceutically acceptable salts of the compounds of the invention include acid addition salts, with inorganic, e.g. nitric, hydrochloric, hydrobromic, sulphuric, perchloric and phosphoric acids, or organic, e.g. acetic, propionic, glycolic, lactic, oxalic, malonic, malic, maleic, tartaric, citric, benzoic, cinnamic, mandelic and salicylic acids, and salts with inorganic, e.g. alkali metal, especially sodium or potassium, bases or alkaline-earth metal, especially calcium or magnesium bases, or with organic bases, e.g. alkylamines, preferably triethylamine.

10

15

As stated above, the present invention also includes within its scope pharmaceutically acceptable bioprecursors (otherwise known as pro-drugs) of the compounds of formula (I), i.e. compounds which have a different formula to formula (I) above, but which nevertheless upon administration to human being are converted directly or indirectly in vivo into a compound of formula (I).

20

- 25 Preferred compounds of the invention are the compounds of formula (I), wherein subject to the above provisos,

- 6 -

Y is tetralin, quinoline or isoquinoline;

n is zero, 1, 2 or 3;

m is zero or 1;

each of R¹ and R² independently is hydrogen or C₁-C₄

5 alkyl;

each of R³ and R⁴ independently is hydrogen, halogen, cyano, carboxy or amino;

R⁵ is hydrogen;

R is defined above; and the pharmaceutically acceptable

10 salts thereof.

More preferred compounds of the invention are the compounds of formula (I), wherein subject to the above provisos,

Y is tetralin or quinoline;

15 n is zero, 1, 2 or 3;

m is zero or 1;

R¹, R² and R⁵ are hydrogen;

each of R³ and R⁴ independently is hydrogen, amino or carboxy;

20 R is as defined above; and the pharmaceutically acceptable salts thereof.

- 7 -

Examples of specific compounds of the invention are the following compounds, which, when appropriate, may be either Z- or E-diastereoisomers or Z, E-mixtures of said diastereoisomers.

- 5 3-[(4'-amino-1'-tetralyl)methylene]-2-oxindole;
 3-[(4'-dimethylamino-1'-tetralyl)methylene]-2-oxindole;
 3-[(4'-carboxy-1'-tetralyl)methylene]-2-oxindole;
 5-hydroxy-3-[(1'-tetralyl)methylene]-2-oxindole;
 5-amino-3-[(1'-tetralyl)methylene]-2-oxindole;
10 5-carboxy-3-[(1'-tetralyl)methylene]-2-oxindole;
 5-hydroxy-3-[(2'-hydroxy-1'-tetralyl)methylene]-2-oxindole;
 5-hydroxy-3-[(4'-hydroxy-1'-tetralyl)methylene]-2-oxindole;
 5-amino-3-[(2'-hydroxy-1'-tetralyl)methylene]-2-oxindole;
 5-amino-3-[(4'-hydroxy-1'-tetralyl)methylene]-2-oxindole;
15 5-carboxy-3-[(2'-hydroxy-1'-tetralyl)methylene]-2-oxindole;
 5-carboxy-3-[(4'-hydroxy-1'-tetralyl)methylene]-2-oxindole;
 5-hydroxy-3-[(4',5'-dihydroxy-1'-tetralyl)methylene]-2-oxindole;
 5-hydroxy-3-[(4',8'-dihydroxy-1'-tetralyl)methylene]-2-oxindole;
 5-amino-3-[(4',5'-dihydroxy-1'-tetralyl)methylene]-2-oxindole;
20 5-amino-3-[(4',8'-dihydroxy-1'-tetralyl)methylene]-2-oxindole;
 5-carboxy-3-[(4',5'-dihydroxy-1'-tetralyl)methylene]-2-oxindole;
 3-[(4'-amino-2'-tetralyl)methylene]-2-oxindole;
 3-[(4'-carboxy-2'-tetralyl)methylene]-2-oxindole;
 5-hydroxy-3-[(2'-tetralyl)methylene]-2-oxindole;
25 5-amino-3-[(2'-tetralyl)methylene]-2-oxindole;
 5-carboxy-3-[(2'-tetralyl)methylene]-2-oxindole;

- 8 -

- 5-hydroxy-3-[(1'-hydroxy-2'-tetralyl)methylene]-2-oxindole;
5-hydroxy-3-[(3'-hydroxy-2'-tetralyl)methylene]-2-oxindole;
5-hydroxy-3-[(4'-hydroxy-2'-tetralyl)methylene]-2-oxindole;
5-amino-3-[(1'-hydroxy-2'-tetralyl)methylene]-2-oxindole;
5 5-amino-3-[(3'-hydroxy-2'-tetralyl)methylene]-2-oxindole;
5-amino-3-[(4'-hydroxy-2'-tetralyl)methylene]-2-oxindole;
5-carboxy-3-[(1'-hydroxy-2'-tetralyl)methylene]-2-oxindole;
5-carboxy-3-[(3'-hydroxy-2'-tetralyl)methylene]-2-oxindole;
5-carboxy-3-[(4'-hydroxy-2'-tetralyl)methylene]-2-oxindole;
10 5-hydroxy-3-[(1',4'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
5-hydroxy-3-[(4',5'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
5-hydroxy-3-[(4',8'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
5-hydroxy-3-[(3',5'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
5-hydroxy-3-[(3',8'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
15 5-amino-3-[(1',4'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
5-amino-3-[(4',5'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
5-amino-3-[(4',8'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
5-amino-3-[(3',5'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
5-amino-3-[(3',8'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
20 5-carboxy-3-[(1',4'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
5-carboxy-3-[(4',5'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
5-carboxy-3-[(4',8'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
5-carboxy-3-[(3',5'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
5-carboxy-3-[(3',8'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
25 5-hydroxy-3-[(1',4',5'-trihydroxy-2'-tetralyl)methylene]-2-oxindole;
5-hydroxy-3-[(1',4',8'-trihydroxy-2'-tetralyl)methylene]-2-oxindole;

- 9 -

- 3-[(8'-oxo-1',4'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
5-hydroxy-3-[(5'-quinolyl)methylene]-2-oxindole;
5-amino-3-[(5'-quinolyl)methylene]-2-oxindole;
5-carboxy-3-[(5'-quinolyl)methylene]-2-oxindole;
5 5-hydroxy-3-[(4'-quinolyl)methylene]-2-oxindole;
5-amino-3-[(4'-quinolyl)methylene]-2-oxindole;
5-carboxy-3-[(4'-quinolyl)methylene]-2-oxindole;
5-hydroxy-3-[(8'-hydroxy-5'-quinolyl)methylene]-2-oxindole;
5-amino-3-[(8'-hydroxy-5'-quinolyl)methylene]-2-oxindole;
10 5-carboxy-3-[(8'-hydroxy-5'-quinolyl)methylene]-2-oxindole;
5-hydroxy-3-[(8'-hydroxy-4'-quinolyl)methylene]-2-oxindole;
5-amino-3-[(8'-hydroxy-4'-quinolyl)methylene]-2-oxindole; and
5-carboxy-3-[(8'-hydroxy-4'-quinolyl)methylene]-2-oxindole;
5-bromo-3-[(8'-hydroxy-5'-quinolyl)methylene]-2-oxindole;
15 5-fluoro-3-[(8'-hydroxy-5'-quinolyl)methylene]-2-
-oxindole;
5-methoxy-3-[(2'-tetralyl)methylene]-2-oxindole;
5-acethoxy-3-[(2'-tetralyl)methylene]-2-oxindole;
5-hydroxy-3-[(4'-hydroxy-1'-tetralyl)methylene]-2-
20 -oxindole;
and if the case the pharmaceutically acceptable salts
thereof.
A further object of the present invention are the
following compounds and the pharmaceutically acceptable
25 salts thereof, which are new and are encompassed by the

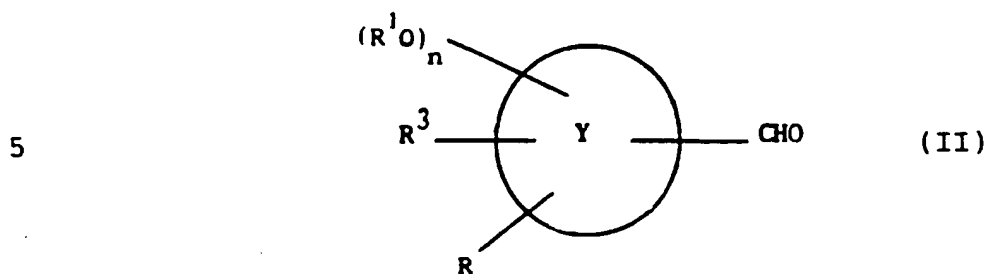
- 10 -

chemical general formula disclosed by WO 91/13055 and WO 93/01182, but therein not disclosed as specific chemical entities:

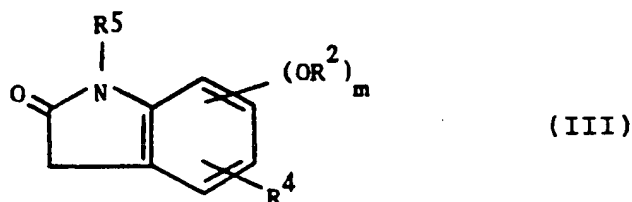
- 3-[(8'-hydroxy-7'-quinolyl)methylene]-2-oxindole;
- 5 3-[(5'-hydroxy-4'-quinolyl)methylene]-2-oxindole;
- 3-[(8'-hydroxy-4'-quinolyl)methylene]-2-oxindole;
- 3-[(2'-methyl-3'-indolyl)methylene]-2-oxindole;
- 3-[(5'-cyano-3'-indolyl)methylene]-2-oxindole;
- 3-[(5'-hydroxy-3'-indolyl)methylene]-2-oxindole;
- 10 3-[(5'-methoxy-3'-indolyl)methylene]-2-oxindole;
- 5-hydroxy-3-[(5'-methoxy-3'-indolyl)methylene]-2-oxindole;
- 5-amino-3-[(5'-methoxy-3'-indolyl)methylene]-2-oxindole;
- 5-hydroxy-3-[(2'-methyl-3'-indolyl)methylene]-2-oxindole;
- 15 2-cyano-3-(4-quinolyl)acrylamide;
- 2-cyano-3-(3-indolyl)acrylamide;
- 2-cyano-3-(1,4-dihydroxy-2-tetralyl)acrylamide;
- 2-cyano-3-(1,4-dihydroxy-2-tetralyl)thioacrylamide;
- 2-cyano-3-(2-hydroxy-1-naphthyl)acrylonitrile;
- 20 2-cyano-3-(2-naphthyl)acrylamide;
- 2-cyano-3-(2-naphthyl)thioacrylamide;
- 2-cyano-3-(3,5-dihydroxy-2-naphthyl)acrylamide; and
- 2-(4-hydroxyphenyl)-3-(1,4-dimethoxy-2-naphthyl)acrylonitrile;
- which when appropriate may be either Z- or E-diastereo-
- 25 isomers or Z, E-mixtures thereof.

- 11 -

The compounds of formula (I), as defined above, and the pharmaceutically acceptable salts thereof can be obtained by a process comprising the condensation of an aldehyde of formula (II)



wherein Y, n, R, R¹ and R³ are as defined above, with a compound of formula (III)



wherein, m, R², R⁴ and R⁵ are as defined above; and if
 10 desired, converting a compound of formula (I) into another compound of formula (I), and/or, if desired, converting a compound of formula (I) into a pharmaceutically acceptable salt thereof, and/or, if
 15 desired, converting a salt into a free compound, and/or, if desired, separating a mixture of isomers of a compound of formula (I) into the single isomers.

Each of the substituents -OR¹, R³ and -CHO in a compound of formula (II) may be independently on either of the

- 12 -

ring moieties of the bicyclic ring systems.

The condensation of a compound of formula (II) with a compound of formula (III) may be carried out according to known methods as herebelow described. For example it may
5 be carried out under the conditions of the Knoevenagel reaction as described, e.g., by G. Jones in Organic Reactions 15, 204(1967). Suitable catalysts are organic bases such as pyridine, piperidine or diethylamine. The condensation may be performed in an inert organic
10 solvent, e.g., pyridine, ethanol, methanol, benzene or dioxane at temperatures ranging from about 0°C to about 100°C. Preferably the reaction is carried out in hot ethanol solution in the presence of piperidine catalyst.

A compound of formula (I) can be converted into another
15 compound of formula (I) according to known methods. For example the de-etherification of a compound of formula (I) wherein one or more -OR¹ and/or -OR² methoxy groups are present to obtain the corresponding hydroxy substituted derivative can be carried out for example
20 with boron tribromide as described by J.F.N. McOmie in Tetrahedron 24, 2289 (1968). The reaction may be performed in an inert organic solvent such as dichloromethane or benzene under an inert atmosphere (e.g. nitrogen) at temperatures ranging from about -78°C
25 to about room temperature.

- 13 -

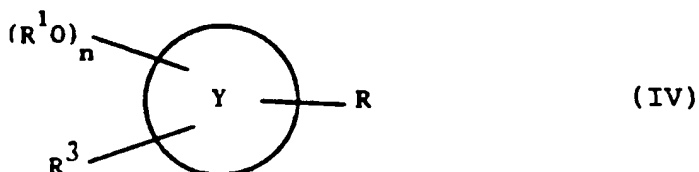
- The conversion of a compound of formula (I) in which R³ and/or R⁴ is nitro into the corresponding compound of formula (I), wherein R³ and/or R⁴ is amino, may be carried out following known methods, for example with a variety of reducing agents, e.g. sodium sulfide in hydroalcoholic solution, metallic iron with ammonium chloride in aqueous solvent, or for instance, catalytic hydrogenation using e.g. palladium charcoal catalyst at low hydrogen pressure in an inert organic solvent.
- 10 The alkylation of a compound of formula (I), wherein -OR¹ and/or -OR² is hydroxy, so as to obtain the corresponding compound of formula (I), wherein -OR¹ and/or -OR² is C₁-C₆ alkoxy, may be obtained, e.g., by reaction with sodium hydride and C₁-C₆ alkyl iodide in a high boiling aromatic solvent such as xylene.
- 15

- The acylation of a compound of formula (I), wherein -OR¹ and/or -OR² is hydroxy, in order to obtain the corresponding compound of formula (I), wherein -OR¹ and/or -OR² is a C₁-C₆ alkanoyloxy, can be performed, e.g., by reaction with a suitable carboxylic acid anhydride in the presence of a basic agent at temperatures ranging from room temperature to reflux temperatures.
- 20

- 14 -

The optional salification of a compound of formula (I) as well as the conversion of a salt into a free compound, and the separation of a mixture of isomers into the single isomers may be carried out by conventional methods. For example the separation of a mixture of geometric isomers, e.g. Z- and E-isomers, may be carried out by fractional crystallization from a suitable solvent or by chromatography, either column chromatography or HPLC.

10 The compounds of formula (II) may be obtained according to known methods from compounds of formula (IV)



wherein Y, R, n, R³ and R¹ are as defined above.

For example when compound (IV) contains phenolic groups, i.e. R¹O⁻ is hydroxy, the well known Reimer-Tiemann method can be applied. Thus the phenolic compound is treated with chloroform and alkali hydroxides in an aqueous or hydroalcoholic solution. Another useful method for the synthesis of aromatic or phenolic aldehydes has been described by H. Gross et al. in Chem. Ber. 96, 308 (1963). Accordingly a compound of formula (IV), in which

- 15 -

the OR¹ group may be present or not, can be treated with a dichloromethyl ether, e.g. dichloromethyl methyl ether, in the presence of a Friedel-Crafts catalyst such as titanium tetrachloride or aluminium trichloride in an inert solvent like dichloromethane or nitrobenzene at
5 temperatures ranging from about 0°C to about 60°C.

The compounds of formula (III) and (IV) are known or may be obtained by known methods.

The new oxindolylidene derivatives and the pharmaceutically acceptable salts thereof, for the first time
10 herein disclosed and encompassed by WO 91/13055 and WO 93/01182, can be obtained by following the same procedure described above for the preparation of a compound of formula (I). Of course a suitable quinoline- or indole-
15 carboxaldehyde has to be chosen as will be easily appreciated by the skilled people in the art.

Similarly the novel acrylamide, thioacrylamide and acrylonitrile derivatives encompassed by the general formula (I) disclosed in WO 91/13055, and mentioned
20 herein for the first time as specific chemical entities, can be obtained by following the procedures described in WO 91/13055 by reacting a suitable quinoline-, tetralin- or naphthalene-carboxaldehyde with cyanoacetamide, cyanothioacetamide or 4-hydroxybenzylcyanide, respec-

- 16 -

tively. When in the new compounds of the present invention and in the intermediate products used for their preparation there are groups present which need to be protected before the above-described reactions are performed, they may be protected before the reaction takes place and then deprotected at the end of the reaction, according to well known methods in organic chemistry. The new compounds provided by the present invention, namely both the compounds of formula (I) as defined above and the new compounds herein specifically disclosed and encompassed by WO 91/13055 and WO 93/01182, are referred to as "the compounds of the invention".

Pharmacology

The compounds of the invention possess specific tyrosine kinase inhibiting activity. It is believed that tyrosine kinase inhibitors may be of great importance in the control of uncontrolled cellular reproduction, i.e. in cellular reproduction disorders. Hence the compounds according to the present invention can be useful in the treatment of pathological proliferation disorders in mammals, including humans.

A human or animal, e.g. a mammal, can thus be treated by a method comprising the administration thereto of a therapeutically effective amount of one of the compounds of the invention. In this way the condition of the human

- 17 -

or animal may be improved. Amelioration of the disease state or disorder from which the human or animal is suffering can be achieved. Typical examples of such disorders are tumours, including leukaemia such as myeloblastic leukaemia, lymphoma, sarcoma, neuroblastoma, Wilm's tumour and malignant neoplasm of the bladder, breast, lung or thyroid; and psoriasis. The compounds of the invention can also be useful in inhibiting the development of the atheromatous plaque and in the control of angiogenesis and as anti-metastatic agents.

Recent studies on the molecular basis of neoplastic transformation have identified a family of genes, designated oncogenes, whose aberrant expression causes tumorigenesis. For example, the RNA tumor viruses possess such an oncogene sequence whose expression determines neoplastic conversion of infected cells. Several of their oncogene-encoded proteins, such as pp60^{v-src}, p70^{gag-yes}, p130^{gag-fps} and p70^{gag-for} display protein tyrosine kinase activity, that is they catalyse the transfer of the γ -phosphate from adenosine triphosphate (ATP) to tyrosine residues in protein substrate. In normal cells, several growth factor receptors, for example the receptors for PDGF, EGF, α -TGF and insulin, display tyrosine kinase activity.

- 18 -

Binding of the growth factor (GF) activates the receptor tyrosine kinase to undergo autophosphorylation and to phosphorylate closely adjacent molecules on tyrosine. Therefore, it is thought that the phosphorylation of these tyrosine kinase receptors plays an important role in signal transduction and that the principal function of tyrosine kinase activity in normal cells is to regulate cell growth. Perturbation of this activity by oncogenic tyrosine kinases that are either overproduced and/or display altered substrate specificity may cause loss of growth control and/or neoplastic transformation. Accordingly, a specific inhibitor of tyrosine kinase can be useful in investigating the mechanism of carcinogenesis, cell proliferation and differentiations and it can be effective in prevention and chemotherapy of cancer and in other pathological proliferative conditions, for instance as mentioned above. The tyrosine specific protein kinase activity of these compounds is shown e.g. by the fact that they are active in the following in vitro and in vivo tests described herebelow.

In vitro ASSAY

p45 v-abl kinase purification. The enzyme used in our test was the p45 v-abl tyrosine kinase which represents the catalytic domain of the Abelson tyrosine kinase (isolated from the Abelson murine leukemia virus). The

- 19 -

p45 v-abl kinase was produced and isolated as described by Wang et al. in J. Biol. Chem. 260, 64 (1985) and by Ferguson et al. in J. Biol. Chem. 260, 3652 (1985) and in Biochem. J. 257, 321 (1989).

- 5 p45 v-abl Kinase Assay. (Val⁵)-Angiotensin II phosphorylation was performed by incubation with 40 ng of purified abl-kinase and (γ -³²P)-ATP, in 50 μ l of buffer containing Tris-HCl 25 mM, pH 8.0, MgCl₂ 10 mM and dithiothreitol 0.1 mM (kinase buffer). The reaction
- 10 mixture was incubated for the indicated time at 30°C and the reaction stopped by adding 50 μ l of 5% trichloroacetic acid. After a brief incubation on ice, tubes were centrifuged. The supernatants were spotted on phosphocellulose paper squares (Whatman P-81) and washed
- 15 extensively in acetic acid. The radioactivity bound to dried phosphocellulose squares was measured in a liquid scintillation counter. IC₅₀ values were calculated from triplicate determinations of each experimental point. Each inhibitor was tested at concentrations ranging from
- 20 0 to 400 μ g in the presence of fixed concentrations of peptide (2 mM) and ATP (50 μ M).

- 20 -

In vivo ASSAY

K562 cell growth inhibition assay. 1 ml of K562 cells, grown in suspension, were incubated for 66 h with or without 10% foetal calf serum in the presence of 1 μ Ci of
5 [3-H]-Thymidine. Cells were harvested, washed three times in cold PBS and treated with 5% trichloroacetic acid for 5 min on ice. After a wash in ethanol: ether 2:1, the DNA was extracted by 0.5 N NaOH for 2 h at room temperature. The extract was counted in a liquid scintillation
10 counter.

The inhibitory activity data for a representative group of compounds according to the present invention, obtained both in the in vitro p45 v-abl kinase assay and in the in vivo human chronic myeloid leukemia K 562 cell growth
15 inhibition assay described above, are set out in following Table 1.

- 21 -

Table 1. Inhibition of p45 v-abl kinase and K562 cell growth.

5	Compound	IC ₅₀ (μM)	
		<u>v-abl</u>	<u>K562</u>
	FCE 27518	6.9	1.2
	FCE 27566	15.6	2.2
	FCE 27565	2.4	-
10	FCE 27866	5.2	8.75
	FCE 27564	0.8	4.15
	FCE 27996	2.6	0.62
	FCE 28359	0.39	8.15
	FCE 28436	0.305	14.50
15	FCE 28337	2.32	11.5
	FCE 28360	4.7	6.25

In the Table :

20 FCE 27518 means : 5-amino-3-[(8'-hydroxy-5'-quinolyl)
methylene]-2-oxindole;

FCE 27566 means : 3-[(2'-methyl-3'-indolyl)methylene]-
-2-oxindole;

FCE 27565 means : 3-[(5'-cyano-3'-indolyl)methylene]-
-2-oxindole;

25 FCE 27866 means : 3-[(5'-hydroxy-3'-indolyl)methylene]-
-2-oxindole;

- 23 -

adopted for oral administration of the compounds 3-[(5'-methoxy-3'-indolyl)methylene]-2-oxindole and 5-bromo-3-[(8'-hydroxy-5'-quinolyl)methylene]-2-oxindole to adult humans may range from about 10 to about 150-200 mg per dose, from 1 to 5 times daily. Of course, these dosage regimens may be adjusted to provide the optimal therapeutic response.

The invention includes pharmaceutical compositions comprising a compound of the invention or a pharmaceutically acceptable salt thereof in association with a pharmaceutically acceptable excipient (which can be a carrier or diluent).

The pharmaceutical compositions containing the compounds of the invention are usually prepared following conventional methods and are administered in a pharmaceutically suitable form.

For example, the solid oral forms may contain, together with the active compound, diluents, e.g., lactose, dextrose, saccharose, cellulose, corn starch or potato starch; lubricants, e.g. silica, talc, stearic acid, magnesium or calcium stearate, and/or polyethylene glycols; binding agents, e.g. starches, arabic gums, gelatin, methylcellulose, carboxymethylcellulose or polyvinyl pyrrolidone; disaggregating agents, e.g. a starch, alginic acid, alginates or sodium starch glycolate, effervescent mixtures; dyestuffs; sweeteners;

- 22 -

FCE 27564 means : 3-[(5'-methoxy-3'-indolyl)methylene]-
-2-oxindole;

FCE 27996 means : 5-bromo-3-[(8'-hydroxy-5'quinolyl)
methylene]-2-oxindole;

5 FCE 28359 means : 5-hydroxy-3-[(5'-methoxy-3'-indolyl)
methylene]-2-oxindole;

FCE 28436 means : 5-amino-3-[(5'-methoxy-3'-indolyl)
methylene]-2-oxindole;

FCE 28337 means : 5-hydroxy-3-[(4'-hydroxy-1'-tetralyl)
10 methylene]-2-oxindole;

FCE 28360 means : 5-amino-3-[(1',4'-dihydroxy-2'-
-tetralyl)methylene]-2-oxindole.

As can be appreciated from the activity data shown in
Table 1, the compounds according to the invention are
15 endowed with valuable biological properties.

In view of their high activity and low toxicity, the
compounds of the invention can be used safely in
medicine.

The compounds of the invention can be administered in a
20 variety of dosage forms, e.g. orally, in the form of
tablets, capsules, sugar or film-coated tablets, liquid
solutions or suspensions; rectally, in the form of
suppositories; parenterally, e.g. intramuscularly, or by
intravenous injection or infusion; or topically.

25 The dosage depends on the age, weight, condition of the
patient and administration route; for example, the dosage

- 24 -

wetting agents, such as lecithin, polysorbates, lauryl-sulphates; and, in general, non-toxic and pharmacologically inactive substances used in pharmaceutical formulations. Said pharmaceutical preparations may be
5 manufactured in known manner, for example, by means of mixing, granulating, tableting, sugar-coating or film-coating processes.

The liquid dispersion for oral administration may be e.g. syrups, emulsions and suspensions.

10 The syrup may contain as carrier, for example, saccharose or saccharose with glycerine and/or mannitol and/or sorbitol.

The suspensions and the emulsions may contain as carrier, for example, a natural gum, agar, sodium alginate,
15 pectin, methylcellulose, carboxymethylcellulose or polyvinyl alcohol.

The suspensions or solutions for intramuscular injections may contain, together with the active compound, a pharmaceutically acceptable carrier, e.g. sterile water,
20 olive oil, ethyl oleate, glycols, e.g. propylene glycol, and, if desired, a suitable amount of lidocaine hydrochloride.

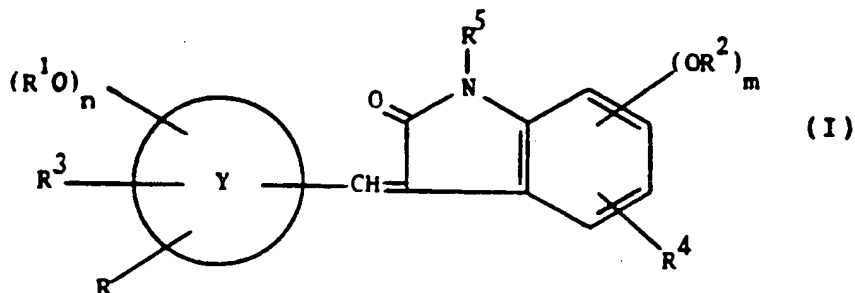
The solutions for intravenous injections or infusion may contain as carrier, for example, sterile water or,
25 preferably, they may be in the form of sterile, aqueous, isotonic saline solutions.

- 25 -

The suppositories may contain, together with the active compound, a pharmaceutically acceptable carrier, e.g. cocoa-butter, polyethylene glycol, a polyoxyethylene sorbitan fatty acid ester surfactant or lecithin.

- 5 Compositions for topical application, e.g. creams, lotions, or pastes, can be prepared by mixing the active ingredient with a conventional oleaginous or emulsifying excipient.

Object of the present invention is also the use of a
10 compound of formula (I)



wherein

Y is a bicyclic ring system chosen from naphthalene, tetralin, quinoline and isoquinoline;

R is hydrogen or an oxo (=O) group when Y is tetralin, or

- 15 R is hydrogen when Y is naphthalene, quinoline or isoquinoline;

each of R^1 and R^2 independently is hydrogen, C_1 - C_6 alkyl or C_2 - C_6 alkanoyl;

m is zero, 1 or 2;

- 20 n is zero, 1, 2 or 3;

- 26 -

each of R^3 and R^4 independently is hydrogen, halogen, cyano, C_1-C_6 alkyl, carboxy, nitro or $-NR^6R^7$ in which each of R^6 and R^7 independently is hydrogen or C_1-C_6 alkyl;

5 R^5 is hydrogen or C_1-C_6 alkyl; and the pharmaceutically acceptable salts thereof; and wherein

a) when at the same time Y is naphthalene; R^3 is hydrogen, halogen, cyano or C_1-C_6 alkyl; R^5 is hydrogen; m is zero and n, R and R^1 are as defined
10 above, then R^4 is other than hydrogen;

b) when at the same time Y is quinoline or isoquinoline; R^3 is hydrogen, halogen, cyano or C_1-C_6 alkyl; n is zero, 1 or 2; R^5 is hydrogen; m is zero and R and R^1 are as defined above, then R^4 is other than hydrogen;
15 and

c) when at the same time Y is tetralin in which only the benzene moiety is substituted, R^3 is hydrogen, halogen, cyano or C_1-C_6 alkyl; n is zero, 1 or 2; R^5 is hydrogen; m is zero, R is hydrogen and R^1 is as
20 defined above, then R^4 is other than hydrogen;

in the preparation of a pharmaceutical composition for use as tyrosine kinase inhibitor, in particular in the treatment of the pathological disorders cited above.

- 27 -

A further object of the present invention is a combined method of treatment of cancer or of amelioration of the conditions of mammals, including humans, suffering from cancer, said method comprising administering

- 5 1) a compound of the invention, or a pharmaceutically acceptable salt thereof,
and
2) an additional antitumor agent, in amounts and close enough together in time sufficient to produce a
10 therapeutically useful effect.

The present invention also provides products containing a compound of the invention, or a pharmaceutically acceptable salt thereof, and an additional antitumour agent as a combined preparation for simultaneous, separate or sequential use in anti-cancer therapy.
15

The term "antitumor agent" is meant to comprise both a single antitumor drug and "cocktails" i.e. a mixture of such drugs, according to the clinical practice.

Examples of antitumor agents that can be formulated with
20 a compound of the invention or alternatively, can be administered in a combined method of treatment, include doxorubicin, daunomycin, epirubicin, idarubicin, etoposide, fluoro-uracil, melphalan, cyclophosphamide, bleomycin, vinblastin and mitomycin or a mixtures of two
25 or more thereof.

- 28 -

The compounds of the invention can therefore be used in a treatment to ameliorate a cancer. They may be administered to a patient suffering from a cancer treatable with an antitumor agent, for example an

5 anthracycline glycoside such as doxorubicin, daunomycin, epirubicin or idarubicin as mentioned above, together with the antitumor agent.

A compound of the invention and an antitumor agent such as an anthracycline glycoside can be administered to

10 improve the condition of a patient having a leukaemia such as myeloblastic leukaemia, lymphoma, sarcoma, neuroblastoma, Wilm's tumor or malignant neoplasm of the bladder, breast, lung or thyroid.

The following examples illustrate but do not limit the

15 invention.

- 29 -

Example 1

5-hydroxy-3-[(8'-hydroxy-5'-quinoly1)methylene]-2-oxindole

A solution of 8-hydroxyquinoline-5-carboxaldehyde (173 mg, 1 mmol), 5-hydroxy-2-oxindole (149 mg, 1 mmol) and piperidine (60 mg, 0.7 mmol) in absolute ethanol (10 ml) was heated for 3 h at 60-70°C under nitrogen. Then the reaction mixture was chilled and evaporated under vacuum to dryness. The residue was submitted to column chromatography over silica gel using dichloromethane/ethanol 4% as eluant to give pure title compound in about 60% yield.

Alternatively, the reaction mixture was concentrated under vacuum and then chilled to 0-5°C, the precipitate filtered, the residue washed with ice-cooled ethanol and finally dried under vacuum. Compounds of higher purity are obtained by further crystallization from ethanol.

$C_{18}H_{12}N_2O_3$	requires:	C 71.05	H 3.98	N 9.20
	found :	C 71.01	H 3.85	N 9.15

MS m/z 304

NMR δ ppm: 6.5-6.7 (m, 3H), 7.20 (d, 1H), 7.62 (dd, 1H), 7.83 (d, 1H), 7.93 (s, 1H), 8.33 (dd, 1H), 8.85 (bs, 1H), 8.93 (dd, 1H), 10.30 (bs, 1H).

- 30 -

According to the above described procedure, the following compounds can be prepared:

5-amino-3-[(8'-hydroxy-5'-quinolyl)methylene]-2-oxindole;

$C_{18}H_{12}N_2O_2$ requires: C 74.98 H 4.20 N 9.72

5 found : C 74.76 H 4.31 N 9.43

MS m/z 288

NMR δ ppm: 6.4-6.6 (m, 3H), 7.18 (d, 1H), 7.62 (dd, 1H),
7.84 (d, 1H), 7.87 (s, 1H), 8.34 (dd, 1H), 8.93
(dd, 1H), 10.14 (bs, 1H).

10 3-[(2'-methyl-3'-indolyl)methylene]-2-oxindole

$C_{18}H_{14}N_2O$ requires: C 78.81 H 5.14 N 10.21

found : C 78.56 H 5.01 N 10.11

MS m/z 274

15 NMR δ ppm: 2.46 (s, 3H), 6.7-6.8 (m, 2H), 6.85 (d, 1H),
7.0-7.2 (m, 4H), 7.41 (d, 1H), 7.80 (s, 1H),
10.48 (bs, 1H), 11.86 (bs, 1H).

3-[(5'-cyano-3'-indolyl)methylene]-2-oxindole

$C_{18}H_{11}N_3O$ requires: C 75.77 H 3.89 N 14.73

found : C 75.71 H 3.55 N 14.51

20 MS m/z 285

NMR δ ppm: 6.8-7.2 (m, 3H), 7.57 (dd, 1H), 7.69 (d, 1H),
7.95 (d, 1H), 8.21 (s, 1H), 8.85 (d, 1H), 9.52
(s, 1H), 10.62 (bs, 1H), 12.4 (bs, 1H).

- 31 -

3-[(5'-hydroxy-3'-indolyl)methylene]-2-oxindole

$C_{17}H_{12}N_2O_2$ requires: C 73.89 H 4.38 N 10.14
found : C 73.55 H 4.36 N 9.97

MS m/z 276

5 NMR δ ppm: 6.75 (m,1H), 6.82 (d,1H), 6.9-7.0 (m,1H),
7.0-7.2 (m,1H), 7.29 (d,1H), 7.42 (d,1H),
7.80 (d,1H), 7.97 (s,1H), 8.96 (s,1H), 9.34
(d,1H), 10.42 (s,1H), 11.8 (bs,1H).

3-[(5'-methoxy-3'-indolyl)methylene]-2-oxindole

10 $C_{18}H_{14}N_2O_2$ requires: C 74.47 H 4.86 N 9.65
found : C 74.35 H 4.72 N 9.54

MS m/z 290

15 NMR δ ppm: 3.87 (s,3H), 6.8-6.9 (m,2H), 7.12 (ddd,1H),
7.38 (d,1H), 7.72 (d,1H), 7.91 (d,1H), 8.13
(s,1H), 9.40 (s,1H), 10.49 (bs,1H), 11.88
(bs,1H).

3-[(8'-hydroxy-7'-quinolyl)methylene]-2-oxindole

$C_{18}H_{12}N_2O_2$ requires: C 74.98 H 4.20 N 9.72
found : C 79.81 H 4.31 N 9.43

20 MS m/z 288

NMR δ ppm: 6.8-6.9 (m,2H), 7.21 (t,1H), 7.48 (m,2H),
7.64 (dd,1H), 7.81 (d,1H), 7.89 (s,1H), 8.38
(dd,1H), 8.91 (dd,1H), 10.6 (bs,1H).

- 32 -

5-hydroxy-3-[(2'-methyl-3'-indolyl)methylene]-2-oxindole

NMR δ ppm: 2.42 (s,3H), 6.30 (d,1H), 6.54 (dd,1H),
6.63 (d,1H), 7.0-7.2 (m,3H), 7.41 (d,1H),
7.73 (s,1H), 8.71 (s,1H), 10.16 (s,1H),
5 11.79 (s,1H).

3-[(4'-amino-1'-tetralyl)methylene]-2-oxindole;

3-[(4'-dimethylamino-1'-tetralyl)methylene]-2-oxindole;

3-[(4'-carboxy-1'-tetralyl)methylene]-2-oxindole;

5-hydroxy-3-[(1'-tetralyl)methylene]-2-oxindole;

10 5-amino-3-[(1'-tetralyl)methylene]-2-oxindole;

5-carboxy-3-[(1'-tetralyl)methylene]-2-oxindole;

5-hydroxy-3-[(2'-hydroxy-1'-tetralyl)methylene]-2-oxindole;

15 5-hydroxy-3-[(4'-hydroxy-1'-tetralyl)methylene]-2-oxindole

NMR δ ppm: 1.69 (m,4H), 2.5-2.7 (m,4H), 6.57 (dd,1H),
6.62 (d,1H), 6.72 (d,1H), 6.88 (d,1H),
7.26 (d,1H), 7.53 (s,1H), 8.87 (s,1H),
9.8 (bs,1H), 10.17 (s,1H).

20 5-amino-3-[(2'-hydroxy-1'-tetralyl)methylene]-2-oxindole;

5-amino-3-[(4'-hydroxy-1'-tetralyl)methylene]-2-oxindole;

5-carboxy-3-[(2'-hydroxy-1'-tetralyl)methylene]-2-oxindole;

25 5-carboxy-3-[(4'-hydroxy-1'-tetralyl)methylene]-2-oxindole;

5-hydroxy-3-[(4',5'-dihydroxy-1'-tetralyl)methylene]-2-

- 33 -

- oxindole;
5-hydroxy-3-[(4',8'-dihydroxy-1'-tetralyl)methylene]-2-oxindole;
5-amino-3-[(4',5'-dihydroxy-1'-tetralyl)methylene]-2-oxindole;
5 5-amino-3-[(4',8'-dihydroxy-1'-tetralyl)methylene]-2-oxindole;
5-carboxy-3-[(4',5'-dihydroxy-1'-tetralyl)methylene]-2-oxindole;
10 3-[(4'-amino-2'-tetralyl)methylene]-2-oxindole;
3-[(4'-carboxy-2'-tetralyl)methylene]-2-oxindole;
5-hydroxy-3-[(2'-tetralyl)methylene]-2-oxindole;
5-amino-3-[(2'-tetralyl)methylene]-2-oxindole;
5-carboxy-3-[(2'-tetralyl)methylene]-2-oxindole;
15 5-hydroxy-3-[(1'-hydroxy-2'-tetralyl)methylene]-2-oxindole;
5-hydroxy-3-[(3'-hydroxy-2'-tetralyl)methylene]-2-oxindole;
5-hydroxy-3-[(4'-hydroxy-2'-tetralyl)methylene]-2-oxindole;
20 5-amino-3-[(1'-hydroxy-2'-tetralyl)methylene]-2-oxindole;
5-amino-3-[(3'-hydroxy-2'-tetralyl)methylene]-2-oxindole;
5-amino-3-[(4'-hydroxy-2'-tetralyl)methylene]-2-oxindole;
5-carboxy-3-[(1'-hydroxy-2'-tetralyl)methylene]-2-oxindole;
25 5-carboxy-3-[(3'-hydroxy-2'-tetralyl)methylene]-2-

- 34 -

- oxindole;
5-carboxy-3-[(4'-hydroxy-2'-tetralyl)methylene]-2-oxindole;
5-hydroxy-3-[(1',4'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
5-hydroxy-3-[(4',5'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
5-hydroxy-3-[(4',8'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
5-hydroxy-3-[(3',5'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
5-hydroxy-3-[(3',8'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
5-amino-3-[(1',4'-dihydroxy-2'-tetralyl)methylene]-2-oxindole
NMR δ ppm: 1.69 (m,4H), 2.58 (m,4H), 6.86 (s,1H), 6.94 (d,1H), 7.15 (dd,1H), 7.60 (d,1H), 7.75 (s,1H), 8.4 (bs,1H), 8.9 (bs,1H), 9.7 (bs,3H), 10.71 (s,1H).
5-amino-3-[(4',5'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
5-amino-3-[(4',8'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
5-amino-3-[(3',5'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
5-amino-3-[(3',8'-dihydroxy-2'-tetralyl)methylene]-2-

- 35 -

-oxindole;

5-carboxy-3-[(1',4'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;

5 5-carboxy-3-[(4',5'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;

5-carboxy-3-[(4',8'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;

5-carboxy-3-[(3',5'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;

10 5-carboxy-3-[(3',8'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;

5-hydroxy-3-[(1',4',5'-trihydroxy-2'-tetralyl)methylene]-2-oxindole;

15 5-hydroxy-3-[(1',4',8'-trihydroxy-2'-tetralyl)methylene]-2-oxindole;

3-[(8'-oxo-1',4'-dihydroxy-2'-tetralyl)methylene]-2-oxindole

NMR δ ppm: 2.03 (m,2H), 2.70 and 2.89 (two m,4H),

20 6.7-7.0 (m,2H), 7.1-7.3 (m,1H), 7.51 (s,1H),
7.54 (d,1H), 7.58 (d,1H), 7.61 (s,1H), 7.87
(s,1H), 8.46 (s,1H), 9.38 (s,1H), 9.56 (s,1H),
10.58 (s,1H), 10.59 (s,1H), 12.5 (bs,1H), 12.8
(bs,1H).

5-hydroxy-3-[(5'-quinolyl)methylene]-2-oxindole;

25 5-amino-3-[(5'-quinolyl)methylene]-2-oxindole;

5-carboxy-3-[(5'-quinolyl)methylene]-2-oxindole;

- 36 -

5-hydroxy-3-[(4'-quinolyl)methylene]-2-oxindole;

5-amino-3-[(4'-quinolyl)methylene]-2-oxindole;

5-carboxy-3-[(4'-quinolyl)methylene]-2-oxindole;

5-carboxy-3-[(8'-hydroxy-5'-quinolyl)methylene]-2-oxindole;

5-hydroxy-3-[(8'-hydroxy-4'-quinolyl)methylene]-2-oxindole;

5-amino-3-[(8'-hydroxy-4'-quinolyl)methylene]-2-oxindole;

5-carboxy-3-[(8'-hydroxy-4'-quinolyl)methylene]-2-oxindole;

5-bromo-3-[(8'-hydroxy-5'-quinolyl)methylene]-2-oxindole

NMR δ ppm: 6.76 (d,1H), 6.83 (d,1H), 7.12 (d,1H), 7.17 (d,1H), 7.22 (d,1H), 7.3-7.4 (m,2H), 7.6-7.7 (m,2H), 7.89 (d,1H), 8.08 (s,1H), 8.17 (d,1H), 8.36 (dd,1H), 8.46 (s,1H), 8.8-9.0 (m,4H), 10.66 (s,1H), 10.77 (s,1H).

5-fluoro-3-[(8'-hydroxy-5'-quinolyl)methylene]-2-oxindole

NMR δ ppm: 6.8-6.9 (m,2H), 7.04 (ddd,1H), 7.22 (d,1H), 7.63 (dd,1H), 7.89 (d,1H), 8.08 (s,1H), 8.37 (dd,1H), 8.94 (dd,1H), 10.5 (bs,1H), 10.65 (s,1H).

3-[(5'-hydroxy-4'-quinolyl)methylene]-2-oxindole;

3-[(8'-hydroxy-4'-quinolyl)methylene]-2-oxindole;

- 37 -

5-hydroxy-3-[(5'-methoxy-3'-indolyl)methylene]-2-oxindole

5 NMR δ ppm: 3.86 (s,3H), 6.5-6.7 (m,2H), 6.82 (dd,1H),
7.36 (m,2H), 7.68 (d,1H), 7.99 (s,1H), 8.82
(s,1H), 9.37 (d,1H), 10.15 (s,1H), 11.8
(bs,1H).

5-amino-3-[(5'-methoxy-3'-indolyl)methylene]-2-oxindole

10 NMR δ ppm: 3.87 (s,3H), 6.87 (dd,1H), 6.90 (d,1H), 7.07
(dd,1H), 7.42 (d,1H), 7.66 (d,1H), 7.81
(d,1H), 8.18 (s,1H), 9.44 (d,1H), 9.65
(bs,3H), 10.67 (s,1H), 12.03 (d,1H).

and

5-hydroxy-3-[(2'-methyl-3'-indolyl)methylene]-2-oxindole.

- 38 -

Example 2

5-hydroxy-3-[(1'-tetralyl)methylene]-2-oxindole

To a stirred solution of 5-methoxy-3-[(1'-tetralyl)methylene]-2-oxindole (305 mg, 1 mmol) in anhydrous dichloromethane (10 ml) was added at -78°C under nitrogen, over a period of 10 min, a 1.0 M solution of boron tribromide in dichloromethane (3 ml, 3 mmol). The resulting mixture was stirred for another 1 h at -78°C and then allowed to warm up to room temperature. After stirring for 1.5 h at 20-25°C the mixture was cooled to -10°C and then quenched by dropwise addition of water (10 ml) over a 10-min period. After addition of ethyl acetate the organic layer was separated, washed with water, dried with Na₂SO₄ and evaporated under vacuum to dryness. The residue was crystallized from ethanol thus giving pure title compound in 70% yield.

C₁₉H₁₇NO₂ requires: C 78.30 H 5.88 N 4.81

found : C 78.15 H 5.75 N 4.71

MS m/z 291

IR cm⁻¹: 3600-2600 (NH,OH), 1655 (amide), 1610 (amide), 1585, 1535 (C=C).

- 39 -

Example 3

5-amino-3-[(1'-tetralyl)methylene]-2-oxindole

To a solution of 5-nitro-3-[(1'-tetralyl)methylene]-2-oxindole (320 mg, 1 mmol) in anhydrous ethanol (20 ml) was added palladium on charcoal (20 mg) and the mixture was hydrogenated at room temperature and atmospheric pressure until 3 equivalent of hydrogen has been taken up. The hydrogen uptake was graphed as a function of time. The catalyst was filtered and the solution concentrated under vacuum until crystallization began. Then the mixture was cooled to 0-5°C, filtered, the residue washed with ice-cooled ethanol and dried under vacuum. Thus almost pure title compound was obtained in about 80% yield.

15 $C_{19}H_{18}N_2O$ requires: C 78.59 H 6.25 N 9.65
found : C 78.45 H 6.13 N 9.55

MS m/z 290

IR cm^{-1} : 3400-3200 (NH), 1660 (amide), 1610 (amide)
1580, 1530 (C=C).

- 40 -

Example 4

5-methoxy-3-[(2'-tetralyl)methylene]-2-oxindole

To a suspension of 95% sodium hydride (28 mg, 1.1 mmol) in DMF (10 ml) cooled with an ice-propanol bath was added over 15 min with stirring a solution of 5-hydroxy-3-[(2'-tetralyl)methylene]-2-oxindole (291 mg, 1 mmol) in DMF (5 ml). When the evolution of hydrogen stopped, a solution of iodomethane (156 mg, 1.1 mmol) in DMF (5 ml) was added over 15 min and the mixture was stirred at room temperature for 3 h. Most of the DMF was distilled off in vacuum, water was then added to the residue and the product extracted into ethylacetate. The organic solution containing the desired product was dried, the solvent evaporated and the remaining oil was crystallized by trituration with ethanol. Thus pure title compound was obtained in about 60% yield.

$C_{20}H_{19}NO_2$ requires: C 78.66 H 6.27 N 4.59

found : C 78.51 H 6.11 N 4.35

MS m/z 305

IR cm^{-1} : 3400-3200, 1655, 1605 (amide), 1580, 1530 (C=C).

- 41 -

Example 5

5-acetoxy-3-[(2'-tetralyl)methylene]-2-oxindole

To a cooled solution of 5-hydroxy-3-[(2'-tetralyl)methylene]-2-oxindole (291 mg, 1 mmol) in dry pyridine
5 (0.5 ml) was added acetic anhydride (306 mg, 3 mmol) and the mixture maintained at 0-5°C overnight. Thereupon the mixture was concentrated under vacuum, the residue dissolved in dichloromethane, the organic layer washed with water and then evaporated under reduced pressure.
10 The crude product was crystallized from chloroform/methanol to yield almost pure title compound in about 80% yield.

$C_{21}H_{19}NO_3$	requires:	C 75.66	H 5.74	N 4.20
	found :	C 75.59	H 5.81	N 4.15

15 MS m/z 333.

- 42 -

Example 6

1,4-dihydroxy-2-tetralincarboxaldehyde

To a solution of 1,4-dihydroxy-tetralin (1.640 g, 0.010 mol) in dichloromethane (50 ml) was added titanium tetrachloride (5.69 g, 0.03 mol). Then 1,1-dichloro-
5 dimethyl ether (1.73 g, 0.015 mol) was added dropwise under vigorous stirring and the reaction mixture stirred for another 3 h at room temperature. Finally 5% hydrochloric acid (10 ml) was added under ice-cooling.
10 The organic phase was separated and the residual aqueous phase repeatedly extracted with ether. The combined organic phases are washed with saturated saline solution, dried over sodium sulfate and evaporated under vacuum. The residue was crystallized from benzene or
15 alternatively submitted to flash chromatography on silica gel with benzene/ethylacetate 85:15 to afford pure title compound in about 60% yield (1.080 g), m.p. 145°C.

MS m/z 180

NMR δ ppm: 10.4 (bs, OH), 9.7 (s, CHO), 9.1 (bs, OH),
20 6.9 (s, H arom), 2.8 (m, 5-CH₂, 8-CH₂), 1.9 (m, 6-CH₂, 7-CH₂).

- 43 -

Example 7

By proceeding according to the technique of above Example 1 and Examples 1, 2 and 7 of WO 91/13055 and starting from a suitable quinoline-, tetralin- or naphthalene-
5 carboxaldehyde and cyanoacetamide, cyanothioacetamide or 4-hydroxybenzylcyanide the following compounds can be obtained.

2-(4-hydroxyphenyl)-3-(1,4-dimethoxy-2-naphthyl)acrylonitrile

10 $C_{16}H_{14}N_2O_3$ requires: C 68.07 H 5.00 N 9.93
found : C 67.98 H 5.02 N 9.92

MS m/z 282

NMR δ ppm: 3.90 (3H,s), 3.99 (3H,s), 7.60 (1H,s), 7.70
(2H,m), 7.8, 8.0 (2H, two S), 8.15 (2H,m),
15 8.49 (1H,s).

2-cyano-3-(4-quinolyl)acrylamide

$C_{13}H_9N_3O$ requires: C 69.95 H 4.06 N 18.82
found : C 69.86 H 4.01 N 18.75

MS m/z 223

20 IR cm^{-1} : 3400, 3299 (NH), 2210 (CN), 1680 (CO),
1610, 1590, 1580 (C=C).

- 44 -

2-cyano-3-(3-indolyl)acrylamide

 $C_{12}H_9N_3O$ requires: C 68.24 H 4.29 N 19.89

found : C 68.11 H 4.21 N 19.85

MS m/z 211

5 IR cm^{-1} : 3400, 3150 (NH), 2220 (CN), 1680 (CO),
1605, 1590, 1580 (C=C).

2-cyano-3-(1,4-dihydroxy-2-tetralyl)acrylamide

 $C_{14}H_{14}N_2O_3$ requires: C 65.10 H 5.46 N 10.85

found : C 65.16 H 5.58 N 10.67

10 MS m/z 258

IR cm^{-1} : 3200-3400 (NH,OH), 2210 (CN), 1680 (CO),
1610, 1595 (C=C).

2-cyano-3-(1,4-dihydroxy-2-tetralyl)thioacrylamide

 $C_{14}H_{14}N_2O_2S$ requires: C 61.30 H 5.14 N 10.21 S 11.69

15 found : C 61.25 H 5.01 N 10.05 S 11.65

MS m/z 274

IR cm^{-1} : 3100-3400 (NH,OH), 2200 (CN), 1620, 1570 (C=C).

2-cyano-3-(2-hydroxy-1-naphthyl)acrylonitrile

 $C_{14}H_8N_2O$ requires: C 76.33 H 3.66 N 12.72

20 found : C 76.11 H 3.71 N 12.73

MS m/z 220

NMR δ ppm: 7.36 (d,1H), 7.5-7.9 (m,2H), 7.99 (d,1H),

- 45 -

8.17 (d,1H), 9.47 (d,1H), 8.79 (d,1H),
9.17 (d,1H).

2-cyano-3-(2-naphthyl)acrylamide

5 $C_{14}H_{10}N_2O$ requires: C 75.66 H 4.54 N 12.60
 found : C 75.63 H 4.51 N 12.65

MS m/z 225

IR cm^{-1} : 3390 (NH), 3180 (NH), 2210 (CN), 1690 (CO),
 1615 (amide), 1595, 1585 (arom).

2-cyano-3-(2-naphthyl)thioacrylamide

10 $C_{14}H_{10}N_2S$ requires: C 70.56 H 4.23 N 11.76 S 13.45
 found : C 69.12 H 4.35 N 11.98 S 13.10

MS m/z 238

NMR δ ppm: 7.65 (2H,m), 8.05 (4H,m), 8.24 (1H,s), 8.44
 (1H,s), 9.68, 10.15 (2H,bs).

15 2-cyano-3-(3,5-dihydroxy-2-naphthyl)acrylamide

$C_{14}H_{10}N_2O_3$ requires: C 66.13 H 3.97 N 11.02
 found : C 66.98 H 3.85 N 10.72

MS m/z 254.

- 46 -

Example 8

Tablets each weighing 0.150 g and containing 25 mg of the active substance, can be manufactured as follows:
composition (for 10,000 tablets):

5	5-amino-3-[(8'-hydroxy-5'-quinolyl)methylene]- 2-oxindole	250 g
	Lactose	800 g
	Corn starch	415 g
	Talc powder	30 g
10	Magnesium stearate	5 g

The 5-amino-3-[(8'-hydroxy-5'-quinolyl)methylene]-2-oxindole, the lactose and half the corn starch are mixed; the mixture is then forced through a sieve of 0.5 mm mesh size.

- 15 Corn starch (10 g) is suspended in warm water (90 ml) and the resulting paste is used to granulate the powder. The granulate is dried, comminuted on a sieve of 1.4 mm mesh size, then the remaining quantity of starch, talc and magnesium stearate are added, carefully mixed and
20 processed into tablets.

- 47 -

Example 9

Capsules, each dosed at 0.200 g and containing 20 mg of the active substance can be prepared:

composition for 500 capsules:

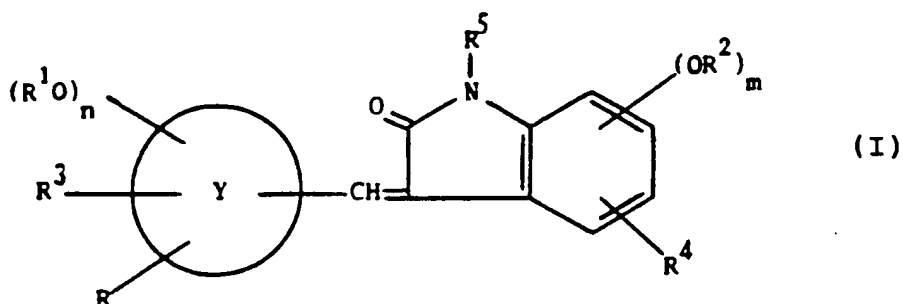
5	3-[(5'-methoxy-3'-indolyl)methylene]-2 oxindole	10 g
	Lactose	80 g
	Corn starch	5 g
	Magnesium stearate	5 g

This formulation is encapsulated in two-piece hard
10 gelatin capsules and dosed at 0.200 g for each capsule.

- 48 -

CLAIMS

1. A compound having the following general formula (I)



wherein

- 5 Y is a bicyclic ring system chosen from naphthalene, tetralin, quinoline and isoquinoline;
 R is hydrogen or an oxo (=O) group when Y is tetralin; or R is hydrogen when Y is naphthalene, quinoline or isoquinoline;
- 10 each of R^1 and R^2 independently is hydrogen, C_1-C_6 alkyl or C_2-C_6 alkanoyl;
 m is zero, 1 or 2;
 n is zero, 1, 2 or 3;
 each of R^3 and R^4 independently is hydrogen, halogen, cyano, C_1-C_6 alkyl, carboxy, nitro or $-NR^6R^7$ in which
- 15 each of R^6 and R^7 independently is hydrogen or C_1-C_6 alkyl;
 R^5 is hydrogen or C_1-C_6 alkyl; or a pharmaceutically acceptable salt thereof; with the provisos that

- 49 -

- a) when at the same time Y is naphthalene; R^3 is hydrogen, halogen, cyano or C_1-C_6 alkyl; R^5 is hydrogen; m is zero and n, R and R^1 are as defined above, then R^4 is other than hydrogen;
- 5 b) when at the same time Y is quinoline or isoquinoline; R_2 is hydrogen, halogen, cyano or C_1-C_6 alkyl; n is zero, 1 or 2; R^5 is hydrogen; m is zero and R and R^1 are as defined above, then R^4 is other than hydrogen;
- 10 c) when at the same time Y is tetralin in which only the benzene moiety is substituted, R^3 is hydrogen, halogen, cyano or C_1-C_6 alkyl; n is zero, 1 or 2; R^5 is hydrogen; m is zero, R is hydrogen and R^1 is as defined above, then R^4 is
- 15 other than hydrogen;
and
- d) when at the same time Y is naphthalene; m and n are zero; R and R^3 are hydrogen; R^4 being linked at the C-4 carbon atom is halogen or C_1-C_4 alkyl,
- 20 then R^5 is other than C_1-C_2 alkyl.

2. A compound of formula (I), according to claim 1, wherein,
Y is tetralin, quinoline or isoquinoline;
n is zero, 1, 2 or 3;

- 50 -

m is zero or 1;

each of R¹ and R² independently is hydrogen or C₁-C₄ alkyl;

each of R³ and R⁴ independently is hydrogen, halogen, cyano, carboxy or amino;

R⁵ is hydrogen; and

R is defined in claim 1; or a pharmaceutically acceptable salt thereof.

3. A compound of formula (I), according to claim 1, wherein,

Y is tetralin or quinoline;

n is zero, 1, 2 or 3;

m is zero or 1;

R¹, R² and R⁵ are hydrogen;

each of R³ and R⁴ independently is hydrogen, amino or carboxy; and

R is as defined in claim 1, or a pharmaceutically acceptable salt thereof.

4. A compound selected from

3-[(4'-amino-1'-tetralyl)methylene]-2-oxindole;

3-[(4'-dimethylamino-1'-tetralyl)methylene]-2-oxindole;

3-[(4'-carboxy-1'-tetralyl)methylene]-2-oxindole;

5-hydroxy-3-[(1'-tetralyl)methylene]-2-oxindole;

5-amino-3-[(1'-tetralyl)methylene]-2-oxindole;

- 51 -

- 5-carboxy-3-[(1'-tetralyl)methylene]-2-oxindole;
5-hydroxy-3-[(2'-hydroxy-1'-tetralyl)methylene]-2-oxindole;
5-hydroxy-3-[(4'-hydroxy-1'-tetralyl)methylene]-2-oxindole;
5-amino-3-[(2'-hydroxy-1'-tetralyl)methylene]-2-oxindole;
5-amino-3-[(4'-hydroxy-1'-tetralyl)methylene]-2-oxindole;
5-carboxy-3-[(2'-hydroxy-1'-tetralyl)methylene]-2-oxindole;
10 5-carboxy-3-[(4'-hydroxy-1'-tetralyl)methylene]-2-oxindole;
5-hydroxy-3-[(4',5'-dihydroxy-1'-tetralyl)methylene]-2-oxindole;
5-hydroxy-3-[(4',8'-dihydroxy-1'-tetralyl)methylene]-2-oxindole;
15 5-amino-3-[(4',5'-dihydroxy-1'-tetralyl)methylene]-2-oxindole;
5-amino-3-[(4',8'-dihydroxy-1'-tetralyl)methylene]-2-oxindole;
20 5-carboxy-3-[(4',5'-dihydroxy-1'-tetralyl)methylene]-2-oxindole;
3-[(4'-amino-2'-tetralyl)methylene]-2-oxindole;
3-[(4'-carboxy-2'-tetralyl)methylene]-2-oxindole;
5-hydroxy-3-[(2'-tetralyl)methylene]-2-oxindole;
25 5-amino-3-[(2'-tetralyl)methylene]-2-oxindole;
5-carboxy-3-[(2'-tetralyl)methylene]-2-oxindole;

- 52 -

- 5-hydroxy-3-[(1'-hydroxy-2'-tetralyl)methylene]-2-oxindole;
- 5-hydroxy-3-[(3'-hydroxy-2'-tetralyl)methylene]-2-oxindole;
- 5 5-hydroxy-3-[(4'-hydroxy-2'-tetralyl)methylene]-2-oxindole;
- 5-amino-3-[(1'-hydroxy-2'-tetralyl)methylene]-2-oxindole
- 5-amino-3-[(3'-hydroxy-2'-tetralyl)methylene]-2-oxindole;
- 5-amino-3-[(4'-hydroxy-2'-tetralyl)methylene]-2-oxindole;
- 10 5-carboxy-3-[(1'-hydroxy-2'-tetralyl)methylene]-2-oxindole;
- 5-carboxy-3-[(3'-hydroxy-2'-tetralyl)methylene]-2-oxindole;
- 5-carboxy-3-[(4'-hydroxy-2'-tetralyl)methylene]-2-
- 15 oxindole;
- 5-hydroxy-3-[(1',4'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
- 5-hydroxy-3-[(4',5'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
- 20 5-hydroxy-3-[(4',8'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
- 5-hydroxy-3-[(3',5'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
- 5-hydroxy-3-[(3',8'-dihydroxy-2'-tetralyl)methylene]-2-
- 25 oxindole;

- 53 -

- 5-amino-3-[(1',4'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
- 5-amino-3-[(4',5'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
- 5 5-amino-3-[(4',8'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
- 5-amino-3-[(3',5'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
- 5-amino-3-[(3',8'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
- 10 5-carboxy-3-[(1',4'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
- 5-carboxy-3-[(4',5'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
- 15 5-carboxy-3-[(4',8'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
- 5-carboxy-3-[(3',5'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
- 5-carboxy-3-[(3',8'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;
- 20 5-hydroxy-3-[(1',4',5'-trihydroxy-2'-tetralyl)methylene]-2-oxindole;
- 5-hydroxy-3-[(1',4',8'-trihydroxy-2'-tetralyl)methylene]-2-oxindole;
- 25 3-[(8'-oxo-1',4'-dihydroxy-2'-tetralyl)methylene]-2-oxindole;

- 54 -

- 5-hydroxy-3-[(5'-quinolyl)methylene]-2-oxindole;
5-amino-3-[(5'-quinolyl)methylene]-2-oxindole;
5-carboxy-3-[(5'-quinolyl)methylene]-2-oxindole;
5-hydroxy-3-[(4'-quinolyl)methylene]-2-oxindole;
5 5-amino-3-[(4'-quinolyl)methylene]-2-oxindole;
5-carboxy-3-[(4'-quinolyl)methylene]-2-oxindole;
5-hydroxy-3-[(8'-hydroxy-5'-quinolyl)methylene]-2-oxindole;
5-amino-3-[(8'-hydroxy-5'-quinolyl)methylene]-2-oxindole;
10 5-carboxy-3-[(8'-hydroxy-5'-quinolyl)methylene]-2-oxindole;
5-hydroxy-3-[(8'-hydroxy-4'-quinolyl)methylene]-2-oxindole;
5-amino-3-[(8'-hydroxy-4'-quinolyl)methylene]-2-oxindole;
15 5-carboxy-3-[(8'-hydroxy-4'-quinolyl)methylene]-2-oxindole;
5-bromo-3-[(8'-hydroxy-5'-quinolyl)methylene]-2-oxindole;
5-fluoro-3-[(8'-hydroxy-5'-quinolyl)methylene]-2-oxindole;
20 -oxindole;
5-methoxy-3-[(2'-tetralyl)methylene]-2-oxindole;
5-acethoxy-3-[(2'-tetralyl)methylene]-2-oxindole;
5-hydroxy-3-[(4'-hydroxy-1'-tetralyl)methylene]-2-oxindole;
25 each compound being in the form of the Z or E-diastereoisomers or a mixture thereof; and the

- 55 -

pharmaceutically acceptable salts thereof.

5. A compound selected from :

- 3-[(8'-hydroxy-7'-quinolyl)methylene]-2-oxindole;
3-[(5'-hydroxy-4'-quinolyl)methylene]-2-oxindole;
5 3-[(8'-hydroxy-4'-quinolyl)methylene]-2-oxindole;
5-hydroxy-3-[(5'-methoxy-3'-indolyl)methylene]-2-oxindole;
5-amino-3-[(5'-methoxy-3'-indolyl)methylene]-2-oxindole;
5-hydroxy-3-[(2'-methyl-3'-indolyl)methylene]-2-oxindole;
10 3-[(2'-methyl-3'-indolyl)methylene]-2-oxindole;
3-[(5'-cyano-3'-indolyl)methylene]-2-oxindole;
3-[(5'-hydroxy-3'-indolyl)methylene]-2-oxindole; and
3-[(5'-methoxy-3'-indolyl)methylene]-2-oxindole,
each compound being in the form of the Z or E-
15 diastereoisomers or a mixture thereof; and the
pharmaceutically acceptable salts thereof.

6. A compound selected from :

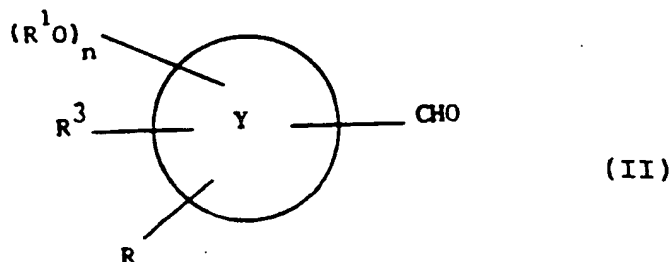
- 2-cyano-3-(4-quinolyl)acrylamide;
2-cyano-3-(3-indolyl)acrylamide;
20 2-cyano-3-(1,4-dihydroxy-2-tetralyl)acrylamide;
2-cyano-3-(1,4-dihydroxy-2-tetralyl)thioacrylamide;
2-cyano-3-(2-hydroxy-1-naphthyl)acrylonitrile;
2-cyano-3-(2-naphthyl)acrylamide;
2-cyano-3-(2-naphthyl)thioacrylamide;

- 56 -

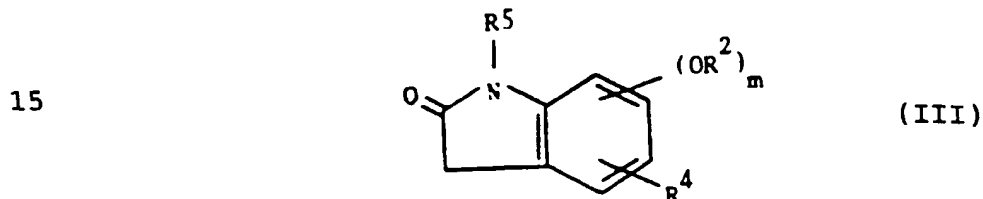
2-cyano-3-(3,5-dihydroxy-2-naphthyl)acrylamide, and
 2-(4-hydroxyphenyl)-3-(1,4-dimethoxy-2-naphthyl)-
 -acrylonitrile,

each compound being in the form of the Z or E-
 5 diastereoisomers or a mixture thereof; and the
 pharmaceutically acceptable salts thereof.

7. A process for the preparation of a compound of
 formula (I) according to claim 1 or a pharma-
 ceutically acceptable salt thereof, the process
 10 comprising the condensation of an aldehyde of formula
 (II)



wherein Y, n, R, R¹ and R³ are as defined in claim 1,
 with a compound of formula (III)



wherein, m, R², R⁴ and R⁵ are as defined in claim 1;
 and if desired, converting a compound of formula (I)

- 57 -

into another compound of formula (I), and/or, if
desired, converting a compound of formula (I) into a
pharmaceutically acceptable salt thereof, and/or, if
desired, converting a salt into a free compound,
5 and/or, if desired, separating a mixture of isomers
of a compound of formula (I) into the single isomers.

8. A pharmaceutically composition containing a suitable
carrier and/or diluent and, as an active principle,
a compound of formula (I) according to claim 1 or a
10 compound according to claim 5 or 6 or a pharma-
ceutically acceptable salt thereof.

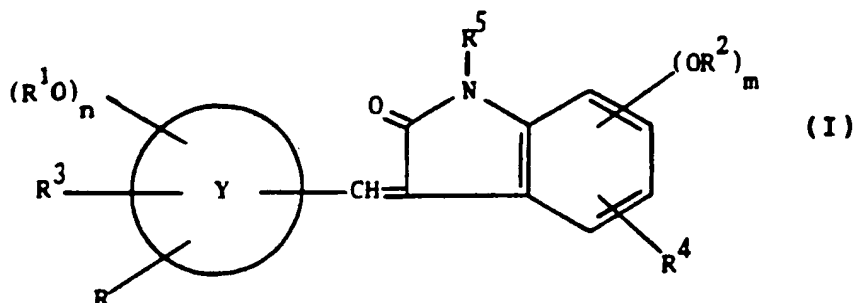
9. A compound according to claims 1, 5 or 6, or a
pharmaceutically acceptable salt thereof, for use as
a tyrosine kinase inhibitor.

15 10. A compound or salt, as claimed in claim 9, for use as
an antiproliferative agent.

11. A compound or salt, as claimed in claim 9, for use as
an anti-metastatic or anti-cancer agent, in
inhibiting the development of the atheromatous plaque
20 or in the control of angiogenesis.

- 58 -

12. The use of a compound of formula (I)



wherein

Y is a bicyclic ring system chosen from naphthalene, tetralin, quinoline and isoquinoline;

5 R is hydrogen or an oxo (=O) group when Y is tetralin, or R is hydrogen when Y is naphthalene, quinoline or isoquinoline;

each of R¹ and R² independently is hydrogen, C₁-C₆ alkyl or C₂-C₆ alkanoyl;

10 m is zero, 1 or 2;

n is zero, 1, 2 or 3;

each of R³ and R⁴ independently is hydrogen, halogen, cyano, C₁-C₆ alkyl, carboxy, nitro or -NR⁶R⁷ in which each of R⁶ and R⁷ independently is hydrogen or C₁-C₆ alkyl;

15

R⁵ is hydrogen or C₁-C₆ alkyl; and the pharmaceutically acceptable salts thereof; and wherein

a) when at the same time Y is naphthalene; R³ is

20

hydrogen, halogen, cyano or C₁-C₆ alkyl; R⁵ is

- 59 -

hydrogen; m is zero and n, R and R¹ are as defined above, then R⁴ is other than hydrogen;

b) when at the same time Y is quinoline or isoquinoline; R₃ is hydrogen, halogen, cyano or C₁-C₆ alkyl; n is zero, 1 or 2; R⁵ is hydrogen; m is zero and R and R¹ are as defined above, then R⁴ is other than hydrogen;

and

c) when at the same time Y is tetralin in which only the benzene moiety is substituted, R³ is hydrogen, halogen, cyano or C₁-C₆ alkyl; n is zero, 1 or 2; R⁵ is hydrogen; m is zero, R is hydrogen and R¹ is as defined above, then R⁴ is other than hydrogen; in the preparation of a pharmaceutical composition for use as tyrosine kinase inhibitor.

13. Products containing a compound of formula (I) as defined in claim 12 or a compound as defined in claim 5 or 6, or a pharmaceutically acceptable salt thereof, and an additional antitumor agent as a combined preparation for simultaneous, separate or sequential use in anti-cancer therapy.

INTERNATIONAL SEARCH REPORT

International Application No.

PCT/EP 94/01715

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 C07D401/06 A61K31/40 C07D209/34

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 C07D A61K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO,A,91 13055 (FARMITALIA CARLO ERBA S.R.L.) 5 September 1991 cited in the application * complete document *	1,6,9
X	EP,A,0 525 472 (FARMITALIA CARLO ERBA S.R.L.) 3 February 1993 cited in the application * complete document *	6,9
X	WO,A,92 07830 (PFIZER INC.) 14 May 1992 * complete document *	1
A	EP,A,0 549 348 (FARMITALIA CARLO ERBA S.R.L.) 30 June 1993 see claims	1,9

☐ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

* Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
E earlier document but published on or after the international filing date
L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
O document referring to an oral disclosure, use, exhibition or other means
P document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
& document member of the same patent family

Date of the actual completion of the international search

21 September 1994

Date of mailing of the international search report

- 3. 10. 94

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax (+31-70) 340-3016

Authorized officer

Van Bijlen, H

INTERNATIONAL SEARCH REPORT

Information on patent family members

Int. .onal Application No

PCT/EP 94/01715

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO-A-9113055	05-09-91	AU-B- 652740	08-09-94
		AU-A- 7241291	18-09-91
		EP-A- 0470221	12-02-92
		JP-T- 4506081	22-10-92
		NZ-A- 237182	23-12-93
EP-A-0525472	03-02-93	AU-A- 2277792	11-02-93
		CA-A- 2091058	13-01-93
		WO-A- 9301182	21-01-93
		EP-A- 0552329	28-07-93
		JP-T- 6501494	17-02-94
WO-A-9207830	14-05-92	NONE	
EP-A-0549348	30-06-93	AU-B- 3167693	28-07-93
		WO-A- 9313012	08-07-93